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THE EYE GNAT IN THE COACHELLA VALLEY, CALIFORNIA

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The adult eye gnat (Hippelates pusio Loew) is a small two-winged fly of a predominantly black color with yellowish legs. It is distinctly characterized by a long black spur on the middle joint of the hind leg.

Although its habit of hovering about the person and especially the face of humans is very annoying, the chief economic importance of the gnat lies in its role as a carrier of eye diseases, especially among children of grammar-school age.

The method of transmission is probably purely mechanical. The gnat feeds around the eyes of a child suffering from conjunctivitis and is disturbed by the movements of the child; then it flies to the eyes of a healthy child, where it introduces the infection. In this manner the spread not only of diseased eye conditions but probably of colds and other infections may become very rapid.

Eye gnats of the genus Hippelates feed not only upon body secretions, sores, wounds, and excretions of both man and animals, but also upon plant and fruit juices, manure, garbage, and, in fact, any substance in a more or less liquid form from which they can derive nourishment.

Although breeding may occur in decaying vegetation or perhaps even in manure or rotting meat, this is not the rule. To permit breeding, any substance must be sufficiently drained and aerated to prevent the concentration of foul gases or liquids. The larvae are easily killed by drowning or suffocation. Therefore, the majority of Hippelates gnats are bred in soil that is (1) light and friable (well drained) and (2) freshly plowed (i.e., plowed not over three weeks before), and that (3) contains abundant humus or vegetable matter (cover crops, manure).

This, it will be noted, is exactly the set of conditions created when cover crops, weeds, pea or bean vines, or manure are plowed or disked under on the majority of ranches in the Coachella Valley, California.

LIFE CYCLE

Under favorable conditions the length of time required from the laying of the egg until the emergence of the gnat is about three weeks. This period may be very slightly shortened (as in midsummer) or may be greatly lengthened (as in winter) by varying conditions of temperature, moisture, or available food supply.

By far the greatest numbers of eggs are laid in October and November. There seems to be a set of conditions created in these months that is highly favorable to eye gnat reproduction. In a normal year probably between 70 and 80 percent of the eye gnats occurring during that year are from eggs deposited the previous fall.

The spring emergence of gnats occurs late in February or early in March and begins after about two or three weeks of continuously favorable weather. Until around the middle of March or the first of April nearly all eye gnats present are those that have overwintered as larvae. After this time, those that have bred in the soil turned under during the spring plowing and cultivating begin to make their appearance.

Although there are as a rule much fewer gnats during July and August, they may still be found in abundance in cool locations in growing crops, tamarisk hedges, etc. This has given rise to the popular though erroneous belief that they breed mostly in such locations.

Upon the advent of more favorable weather in the fall, the gnats begin to lay eggs in full force and continue to do so, generation after generation, at about 3-week intervals until cold weather. After the first few cold nights most of the adult gnats die. A few, however, survive in protected locations and may be found on any warm day during the winter on the warm south side of buildings or windbreaks.

As previously indicated, most of the gnats pass the winter in the larval or maggot stage, and then pupate and emerge in the spring. Some, however, from eggs laid slightly earlier, have already reached the pupal stage when cold weather arrives. These may emerge as adults during any slightly protracted warm spell in the winter.

Overwintering larvae have been found comparatively deep in the soil (4 to 6 inches) during cold weather. At this time they do but little feeding, but as soon as the temperature rises they resume activity. After about 2 weeks of feeding they work their way to within 1½ inches of the surface of the soil and pupate. At this season as many as 150 pupae have been taken from an area of soil 4 by 4 inches.

The egg, larva, pupa, and adult stages may be briefly described as follows:

The egg is very small, banana-shaped, pearly white, and ridged lengthwise by numerous small "flutings." From 20 to 40 are laid by one female; and since female gnats have been kept alive in captivity for 18 days after egg laying, they are probably able to develop a second "batch." Eggs may hatch within 2 or 3 days.

The larva is small, maggotlike, and whitish. It feeds and propels itself by means of mouth hooks, as do many other fly larvae. The larvae, under favorable conditions, feed for about 5 to 10 days.

After the larvae have finished feeding they become "fattened", much shorter, very sluggish, and of a yellowish color. This is the prepupal stage and lasts for only a day or so.

The pupal stage follows the prepupal stage. The pupa is of a chestnut brown color, rather lozenge-shaped, flattened at the sides of one end. The cast-off skin of the mature larva has become the protective coat beneath which the maggot undergoes the change into the adult.

Adults, when first emerged, are whitish yellow and their wings are still folded. After drying and "pumping" out the wings they become typical eye gnats.

CONTROL MEASURES

Experimentation to discover a control for eye gnats has been undertaken along four separate lines, as follows: (1) trapping and baits, (2) sanitation and clean-up, (3) cultural methods, and (4) chemicals.

Trapping and baits

Trapping is the only method that has in itself resulted in any noticeable control. There is no doubt that when trapping is accompanied by a sanitation and clean-up program the gnat population may be greatly reduced around dwellings or in similar small areas.

A great number of traps of various types have been constructed. They range from the large box traps now located around the schools of the Coachella Valley to small traps suitable for use around homes, in garages, etc.

Very efficient traps may be constructed from almost any available materials as long as the following features are included: (1) A darkened bait chamber or entrance chamber, (2) a good bait, and (3) a glass jar, or other "light chamber", the entrance to which is at or near the top of the bait chamber. Of course all joints and cracks must be made tight; otherwise, the gnats, which are very small, will escape from the traps.

With the inclusion of these three features, traps may be made from boxes, tin cans, barrels, or almost any kind of a receptacle. Drawings are presented to show possibilities. (See last page.)

Many substances, both chemical and organic, have been tried as baits. Of all these, liver bait is most efficient. This will be furnished by the Coachella Valley Abatement District*/ free to any resident of the Valley interested in reducing the gnats around his house. Traps cannot be furnished; they must be constructed by those who wish to use them. If preferable, bait

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*/ Phone E. P. Carr or see Glenn O. Robertson.

may be made by placing 1 pound of ground or finely chopped liver in a glass jar and allowing it to become black. The resulting liquid may be diluted greatly to reduce the odor. Baits identically made vary greatly, but some may be diluted to a proportion of about 2 tablespoonfuls of the bait to a quart of water. If this proportion does not work, increase the strength of the bait until it does. In warm weather baits lose their power rapidly and should be changed every 2 or 3 days.

Containers for bait may consist of any dish, can, jar, or crock with a wide mouth. Crockery is better than tin, but if the bait is changed often this should be of little importance. One-pound coffee tins have been successfully used.

Traps should be located facing south or west and preferably placed within a few feet of the lee side of a windbreak or building, with the light chamber facing the strongest light.

Sanitation and clean-up

Sanitation and clean-up consist of the removal of garbage, manure piles, refuse heaps, etc., and the cutting of long grass and low shrubbery from around the premises. Decaying vegetable or animal matter attracts gnats, and the rest of the materials furnish shelter against heat, wind, and cold. In combination with trapping, this program should in a short time prove very effective.

Cultural methods

Somewhat over 900 settings of field cages have been made. These have shown the following effect of cultural methods:

A. Flood irrigation results in the breeding of slightly fewer gnats than furrow irrigation.

B. Light disking results in the breeding of slightly fewer gnats than heavy disking or plowing.

C. Turned-under vegetation breeds gnats in direct proportion to the amount turned under, with very little difference between the cover crops used. The possible exception to this is mustard, which has indicated some measure of control.

D. Practically no breeding occurs in soil over three weeks after it has been plowed.

E. There is very little breeding during the hottest and most humid summer periods late in July and early in August, and very little during the period covering December and January.

F. (Conclusion from D and E.) If soil were plowed during the two periods mentioned instead of 3 weeks later, the gnat population might be greatly reduced.

CHEMICALS

Although the experiments with chemicals carried on at this station have proved very little to date, there is a possibility that in the future some chemical substances may be utilized in one or more of the following manners:

A. As baits.

B. In baits (1) to disguise the odor; (2) to add to attracting power.

C. As repellents (1) to be used in and around buildings or in a lotion on the face and hands to keep the gnats away; (2) applied to the soil to prevent egg laying.

D. As poisons for adult gnats.

E. As poisons for larvae (1) applied in irrigation water, (2) applied as sprays or dusts on cover crops before plowing, and (3) applied after plowing as dusts or sprays.

The cooperation of all Valley people and of the Mosquito Abatement District has been very pleasing and gratifying, and the patience shown with the seemingly slow progress made is very encouraging.

EXPLANATION OF DRAWINGS

Symbols applying to all figures:

a. Bait chamber.
b. Entrance to bait chamber.
c. Light chamber.
d. Standard for lean-to trap (optional).
e. Entrance to light chamber.
f. Awning over entrance to bait chamber in the lard can trap, formed by bending upwards the cut-out used to form entrance.

Description of figures:

Figures 1, 2 and 3 are the front, side and rear views respectively of the lean-to trap. This is constructed as follows:

Front; 8" high by 6" wide, a hole bored at top center to fit half-gallon mason jar lid.

Sides, 8" high in front, 6" high in the rear, 6" wide at bottom.

Top, 8" long, 6" (plus twice the thickness of the material used) wide.

Bottom, 4" long, 6" (plus twice the thickness of the material used) wide.

Standard, a piece of 1" x 3" wood 4 feet long may be nailed to one side as a support if desired.

This provides a small trap into which a coffee can or other bait container may be inserted through the opening or entrance in the rear. No doors, baffles or other constructions are necessary.

Figure 4 shows the construction of a trap from a lard can. Holes 4" wide at the bottom, tapering to 2" at the top, may be cut near the bottom of the can. The cut-out tin may be left intact along the top of the hole and turned up to form an awning (f). Bait is placed directly in the bottom of the lard can.

Figure 5 is a miscellaneous trap that may be constructed from an old box or barrel. Naturally, since the box is also the light chamber it must be covered with glass or very fine (60 mesh) screen. It must also be of a tight construction to prevent the escape of the gnats. The entrances in this case are also the bait chambers and are constructed exactly like the lean-to trap, except on a smaller scale, varying in size with the size of the box or barrel used.

Figures 6, 7, and 8 show the front, side, and rear of the simple box trap. This trap consists of a wooden box (used as a bait chamber) 6" wide x 12" long x 12" deep. Unless this is used with a standard similar to that suggested for the lean-to trap, no bottom is required. A hole large enough to hold the lid of a half-gallon mason jar is bored in the top of the center of the front. The entrance holes are truncate inverted V-shaped holes cut in the rear and sides as illustrated. The side holes may be cut about 4 inches at the bottom and about 3 inches deep, leaving the top 2 inches wide. The rear hole may cover the entire width of the bottom and may be 4 inches deep and 4 inches across the top. The size of these holes may vary without harm.

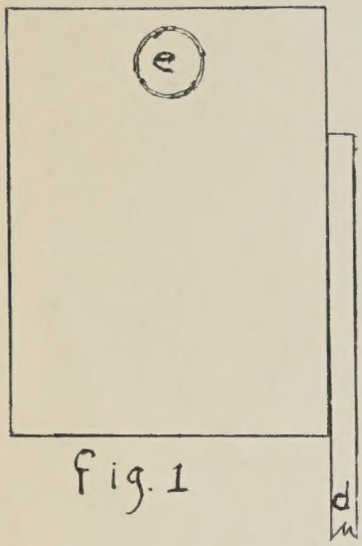

fig. 1

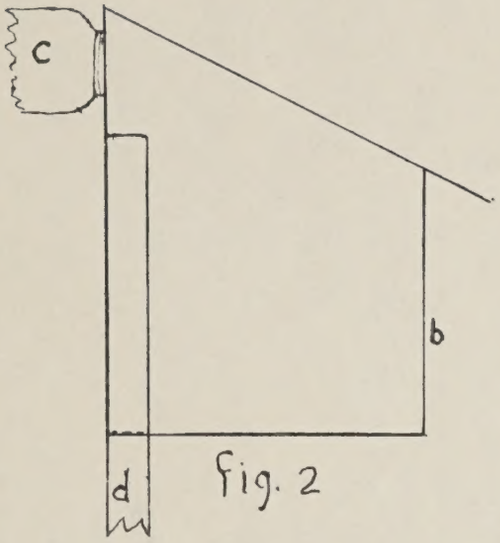

fig. 2

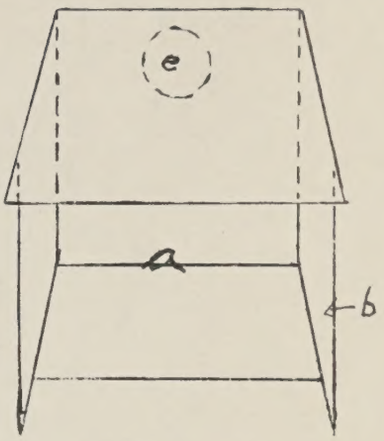

fig. 3

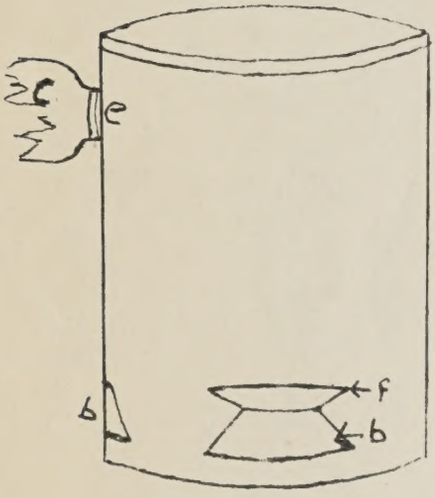

fig. 4

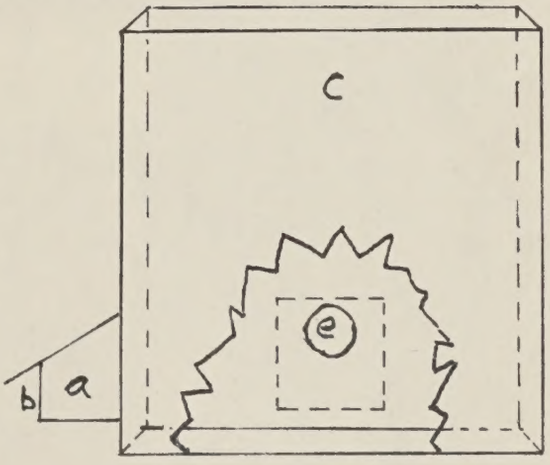

fig. 5

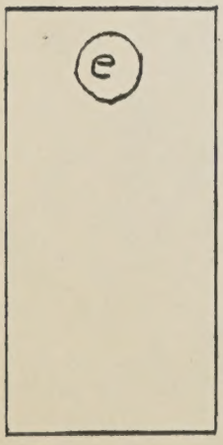

fig. 6

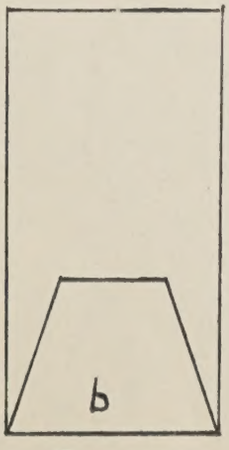

fig. 7

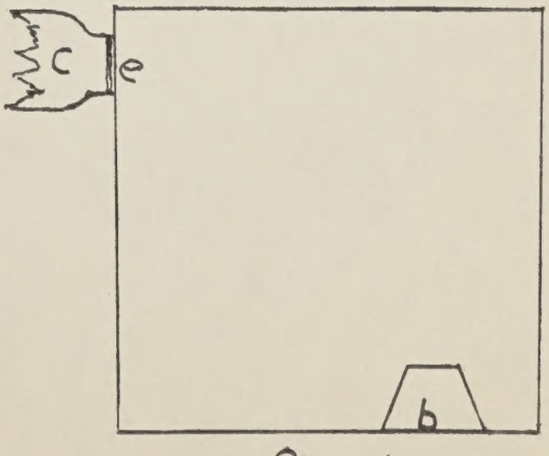

fig. 8

Drawings showing construction of simple traps for catching eye gnats.